Mobile Thermal Printer with Bluetooth Interface for Receipting the Proxy Payments of Consumers of Power

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ABSTRACT
Business transactions in service industry encourage proximity payments accompanied by receipting on the spot and door delivered. Every family in village/city is a power consumer and needs an easy and comfortable means to pay heir EB bills which entitles them for a receipt. The deployment of Mobile Thermal printer with Bluetooth interface with internet enabled handheld device is proposed as an appropriate solution for simplifying and making receipting process comfortable to the consumers of State Electricity Board on their spot *in lieu* of the Payment Collection Centers issuing the receipt for payments, summoning the consumers to the centers. Power supply is the domain of the State Electricity Board (EB), a unit of the state Government. Every consumer has to travel a distance away from his place of living or business with cash or demand draft suffering some risk and troubles while paying their dues. Though people are accustomed in majority to pay in cash regularly for the consumption of electricity every month, they suffer not from monetary constraints but the means of reaching the payment centre. The present paper offers a better alternative with Mobile thermal printer with Bluetooth interface for payment and receipting process.
Keywords: Proxy Payments; Mobile thermal printer; Bluetooth interface; Printed Receipts.

1. INTRODUCTION
Electronic Communication Systems deployed in electronic billing and payment for 'on the spot' transaction has been witnessing a tremendous growth
based on Research and Development in the context of Mobile Thermal Printer with Bluetooth Technology and their application to issuing Theatre tickets, ticketing the traffic offenders by the Police Department and the like. The Bluetooth standard provides interfaces for a wide range of communications protocols, from a simple serial port to variety of applications including audio. The explosion of portable information devices and the increasing use of wireless technology have prompted more and more companies – both Private and Public, to connect their field workers to complete transactions at the point-of-sale or point-of-service itself.

Electronic payment refers to cash and associated transactions implemented by linking to remote servers in the cloud. Electronic payment system involves the use of computer networks, hand held devices/mobile phones and Mobile Thermal Printer with Bluetooth technology. This paper may suit the environment of the whole or a majority of citizens as power consumers in each district of a state.

2. ELECTRONIC COMMUNICATION SYSTEM FOR BILLING AND RECEIPTING PAYMENT
Basically, the system for billing and payment involves two sides namely server and client side. The technology involved in developing the server side starts with the creation of a well articulated, full fledged database of consumers or customers in a Relational Database Management system (RDBMS) require the back end and front end software support.

A roaming staff may handle the issue of the bill for the product or service marketed. The client may get the comfort of paying on the spot either at home or at the company and get the receipt when internet enabled, handheld device and mobile thermal printer with Bluetooth technology are deployed.

Bluetooth is short-range wireless data communications that allow devices to communicate with each other using secure radio waves. Bluetooth evolved as a basic *cable replacement* technology. Bluetooth operates in the 2.4 GHz Industrial, Scientific and Medical (ISM) band which is open, unlicensed and available for use everywhere. Bluetooth has been designed with a potential to operate in noisy environments.

It nominally operates within a 10-meter range. Since it is a radio link, Bluetooth is not limited to line-of-sight and can pass through walls.

3. PROBLEM STATEMENT
The paper discusses Proximity Payments and Receipting – a new concept that has been bringing in faster changes among the modes of Electronic Payments. In an Indian environment, people prefer to pay in cash, get a receipt and retain it in a file. Proximity payments facilitate the comfort and preference of the Indian tariff payers. Proximity payments [1] are the transactions that are conducted without much of manual operations, mostly through a point-of sale device. Among the various modes of electronic payments, the consumer's details residing in a Server could be obtained in a mobile phone, PDA or a handheld device and transactions could be beamed using a wireless Bluetooth protocol actuating a Mobile Thermal Printer for generating a printed receipt.

The core of the paper describes an attempt to design a comfortable Proxy Payment and Receipting system supported by Electronic Communication gadgets utilizing

the existing database of consumers at the Server of the State Electricity Board which is distributing power connection in every state and collecting due tariff from each of the consumers with Power Connections. This work aims to achieve the objective by using Mobile Thermal Printer with Bluetooth interface as components of the Electronic Payment and receipt generating process.

3.1 Paying For Power Consumption: Existing Design

Having a power connection at every home or building is universal. Almost every State Electricity Board (EB) has developed a database of its power consumers. The EB staff visits every home or company to collect data for the consumed power/electricity by taking the meter reading. The staff records the units of power consumed simultaneously on the meter reading entry card and into the hand held device in his possession. At the end of the process, the staff inputs the collected data into the EB main server through the desktop computer at the Collection Centre. The long time custom is that the consumers take the meter usage entry card to the EB payment Collection Centre' and pay either in cash or in Demand Draft form. The due for each consumer is calculated and generated and forwarded to the collection centre when the staff contacts the EB server at the time of consumer paying the bill. Payment is acceptable also in Scheduled Banks and Post offices on a surcharge facilitating either cash or electronic money transfer from the receiving end. But, a majority of the consumers in good number flock there in front of Electricity Board payment collection centers with cash in their hands which is the popular method of payment in India.

Existing systems in power consumption payment and receipt require the consumers travel to the authorized Collection Centers or Bank Branches or Post Offices. In general they need to queue up to pay their dues at the payment counters. This present set up involves time and energy on the part of the consumers. An eleventh hour rush is found common.

3.2 Paying for Power Consumption: Proposed Receipting Design

The proposed design involves the provision of a hand held device with Internet connectivity and a Mobile Thermal Printer to each of the Meter reading staff in the EB. The meter reading staff presses the Service Connection Number of each consumer and the relevant current meter reading and the data the staff presses on to his hand held device is input into the EB Server database. When the consumer pays the dues to the visiting staff, the Server is accessed instantaneously and the particulars of payment are displayed on the screen of the hand held device. When the staff presses the "Print" button the Mobile Thermal Printer with Bluetooth interface is actuated. The printed receipt is removed from the printer and issued to the consumer immediately.

The implementation of the proposed paper hopefully will benefit both the Electricity Board and the consumers as well. Power consumers need not travel to queue up at the Collection points because the Meter reading staff access the database at the main server from their handheld device, get the data for specific consumer, just activate the mobile thermal printer with Bluetooth interface, get the printed

receipt on the consumer's paying the dues on the spot. The staff may use mobile phones *in lieu* of a handheld device.

The proposed new system can reduce also the size and quantum of paper to print the receipts for payment. Mobile Thermal Printers reduce the carbon footprints by opting the sleep mode when not in use unlike the previous models of printers.

4. OBJECTIVE OF THE STUDY
The aims of the investigation are as follows:

a) To develop an electronic Proxy Payment system using Mobile Thermal Printer with Bluetooth interface technology and thereby

b) To provide an automated receipting system for the payment made by the power consumption by the consumers substituting the existing manually operated semi automated system of payment and receipting process of the Electricity Board.

4.1 Significance of the Study
This electronic payment system using Mobile Thermal Printer with Bluetooth interface can facilitate proxy payment and receipting to the benefit of the society as a whole as each family happens to be the consumers of power as well as mobilize funds in time into the State EB. Mobile Thermal Printer with Bluetooth interface makes receipting process instantaneous and on the spot. Electronic Communication gadgets reduce the incidence of time and distance. Waiting Time, fueling the vehicles and traveling a distance to reach the payment centers is saved. Without queuing, power consumers can make transactions fast. Delayed payments and the subsequent additional payment or temporary power disconnections are avoided. Faster mobility of funds from the consumers to the Government is ensured.

The payment centers of the Electricity Board also get the benefit from this system. They can profit more by reducing staff man-hours, the usage of paper and carbon ribbons to print the power consumption payment receipt.

5. REVIEW OF LITERATURE
The IEEE Project 802.15.1 [2] has derived a Wireless Personal Area Network standard based on the Bluetooth v1.1 Foundation Specifications. The lower transport layers (L2CAP, LMP, Baseband, and radio) of the Bluetooth wireless technology are defined. Ehsan Bayaki, Lutz Lampe, and Robert Schober [3]. developed an evaluation framework, which includes the spatial distribution of Bluetooth devices, path loss, fading, realistic data traffic models, scheduling, automatic repeat request (ARQ), and baseband packet selection. David Kammer., et al.,[4] published a book that teaches what Bluetooth technology is all about, and how to write Bluetooth applications for several popular operating systems. A White paper [5] on Understanding and Evaluating Mobile Printer Performance explains, how to identify the Features and Factors such as print speed, size, weight and power requirements are all listed on printer spec sheets. Naser Movahhedinia and Behrouz Shahgholi Ghahfarokhi [6]in their paper analysed the situation regarding Bluetooth for *ad hoc* wireless communication between embedded devices, in a range of 10m. Due to unreliable nature of wireless media, a Channel

Failure Rate (CFR) has been assumed. This system has been investigated analytically and its performance has been evaluated. Li Bai., G. Kane, and P. Lyons [7]in their paper presented a commercial-off-the-shelf (COTS) prototype design for a handheld, contactless, smartcard-based unit for the mass transit and regional rail systems. Jelelna Misic and Vojislav B.Misic, [8], analyzed the performance of Bluetooth piconets under bursty traffic and finite buffer sizes.

6. HANDHELD DEVICE APPROACH

The Power distribution system in any state in India is in a semi-automated, networked environment. On the Server side, the profile of each consumer with a Power Service Connection in every identified geographic locality remains stored in a remote Server sufficiently backed by required Hardware and Software. The Desktop systems at the Tariff Collection Centers are connected to the remote server. The network connection and services end up with the systems at Tariff Collection Centers. A handheld device already is available with every EB staff recording the Power consumption meter reading. Part of the solution will include a model of the handheld device based on a development platform. The model should emulate an actual handheld device in most areas, except for mobility considerations

7. DESIGN PERSPECTIVES

The system design solution is to be cast so as to accommodate the requirements and fulfill the objectives. The design perspectives are detailed below:

• Handheld Device with Wireless communication

The model found befitting the proposed design is a handheld device with a capability of two-way communication with a remote server. The handheld is to be commissioned for sending the data regarding the units of power consumption by every specific Power service connection with a unique number, receive invoice, updates, and any other information necessary for receipting the payment received from the consumer.

• Calculating, Billing and Receipting Process

Calculating, Billing and Receipting Process are to be vested with the remote server of the EB. The remote server maintained at the EB Headquarters, based the input data for each and every consumer identified with specific Power service connection identification number, shall calculate the payment particulars, present a bill format on request from a specific handheld device and send a receipt to be printed on pressing the print button on receipt of payment form the consumer.

• Software Requirements: Compatibility

The software package at the Server should be able to communicate with the handheld device that should allow the staff recording the Power consumption input the permissible designed data into the server and should facilitate the required feedback in the form of a invoice display and allow the receipt to be printed on the payment confirmation of the staff. The software package should have all the required features of a Relational Database Management System (RDBMS).

7.1 Mobile Thermal Printer: General Features

Thermal technology provides a simple mechanism for a mobile thermal printer which is characterized as a quiet, highly reliable, rugged, clean, mechanically simple, relatively low power (as compared to impact) and attractively low cost method of printing that is adaptable to serial or line print head configurations. The technology is extendible, and it is now also being developed for high quality images in full colour. The basic components of thermal printing are the print head and the receiving medium and the paper. The different printer types can employ either serial or line print heads, with black or Gary scale capability, and today advanced models provide print in full colour.

7.2 Bluetooth : General Features

Bluetooth technology has become the hero of the present day wireless electronic communication system. The IEEE 802.11b or Wi-Fi standard is becoming accepted as the choice for the networking community. It supports features that enable the performance of handovers between access points, effectively evolving a transparent wireless network. IEEE 802.11b has a data throughput of up to 11 Mbps, which gives it viability against wired networks. This is evolving further with the advent of IEEE 802.11a. The present day developments has been promoting Electronic Communication with the means to create wireless, low-power, cost-effective, unconscious and ad-hoc connectivity between communicating devices. Its name is Bluetooth.

Bluetooth is a specification for the use of low-power radio communications to wirelessly link phones, computers and other network devices over short distances. In the context of networking, Bluetooth uses a master/slave device relationship to create what is known as a Piconet. One device within the Piconet network is the master device that generates a Frequency Hopping pattern. A maximum of seven slave devices can participate in a single network. A slave device can also participate in another different Piconet. In addition, the master device of one Piconet can act as a slave device for a different Piconet. Wireless signals transmitted with Bluetooth cover short distances, typically up to 30 feet (10 meters). Bluetooth devices generally communicate around 1 Mbps. Some of the advantages include factors like the system operates globally, supports peer connectivity without any wired infrastructure. It supports voice, data and multimedia applications. The radio transceiver is very small and operate at low power—i.e., the radio fits into small, portable devices, such as mobile phones, headsets, and Personal Digital Assistants (PDAs). Bluetooth operates at a frequency of 2.4GHz. This frequency can also be used by IEEE802.11b/g wireless LAN and microwave devices. Bluetooth uses a Frequency Hopping method. When a specific frequency is being used by another device and causing interference, Bluetooth technology will quickly move to a different frequency to minimize cross-talk that could prevent noise in the communication.

The master device generates this frequency shifting pattern which is then followed by the slave device.
An encryption function encrypts the communication data as well, making it very difficult for data to be decrypted by an external device. The master device sets the active mode, standby mode or the sleep mode during and before

and after communication leading to power economy promoting green computing. The ribbon less printing mode reduces carbon footprints.

8. Design and Mode of Operation

The staff is provided with an internet enabled hand held device instead of a just calculating and recording handheld device. The interface between the handheld device upward with the Server and downward with the mobile thermal printer shall have to be designed on the lines of embedded system with bluetooth technology and internet involving hardware components and software programs.

8. CONCLUSION

Mobile Thermal Printers with Bluetooth interface are already found to be more useful for comfortable market-ticketing sector. It can receive communication originating from the remote Database servers through Internet enabled handheld devices. The electronic communication from the handheld device is a one way traffic to the Mobile Thermal Printer with Bluetooth interface, may it be a specific application oriented hand held device or even mobile phones. The service design shall benefit both the State EB and the consumers having Power connection facilitating on the spot proxy payment ensuring a prompt receipting process authenticated by the State EB from its remote server. This proposed design with electronic device components is a Server-Internet enabled Handheld Device Mobile Thermal Printer with Bluetooth interface. The test run with a laptop as a server was conducted at the Laboratory obtaining fruitful results.

9. REFERENCES

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